



California Department of Transportation
Transportation System Information Program

**Transportation System Performance Measures
Proof-of-Concept Testing for Economic Well-Being**
Technical Memorandum



Booz-Allen & Hamilton Inc.
July 2000

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BOOZ-ALLEN & HAMILTON INVESTIGATED THE AVAILABILITY OF EVALUATION TOOLS AND TESTED POTENTIAL INDICATORS FOR THE ECONOMIC WELL-BEING OUTCOME

- The testing showed that the REMI regional economic model can measure transportation system economic well-being, regardless of the indicator chosen
- Economic well-being is more suited for forecasting than monitoring. Specific causes for changes in the economy cannot be isolated, because many socio-economic factors influence the economy. Including an economic well-being component in reports that monitor the transportation system would be difficult
- Three indicators match the outcome definition provided by the policy committee:
 - Gross Regional Product
 - Demand
 - Output
- The current definition does not appear to capture fully the impact on people/households who are the ultimate consumers of transportation systems. The policy committee should consider modifying the outcome definition to include "standard of living." This new definition leads to two additional indicators: employment and personal income
- The "transportation-related" aspect of the definition can be met by focusing on specific industries or by looking at the impact of transportation investments on all industries
- Examining the impact of transportation investments on all industries is the preferred approach. Investments can be considered individually or as groups of projects

THE NEXT PAGE SUMMARIZES THE FINDINGS AND RECOMMENDATIONS

DETAILED FINDINGS AND RECOMMENDATIONS FOR ECONOMIC WELL-BEING...

OUTCOME	INDICATOR	FINDINGS	CONCLUSIONS	RECOMMENDATIONS
Economic Well-Being	<ul style="list-style-type: none"> Three indicators meet the current outcome definition: <ul style="list-style-type: none"> Gross Regional Product Demand Output Other indicators, if definition is modified to include "standard of living," are: <ul style="list-style-type: none"> Employment Personal Income 	<ul style="list-style-type: none"> Three indicators match the outcome definition Other economic indicators (e.g., employment & personal income) are also worth considering Regional economic modeling is the most appropriate framework for forecasting economic well-being Economic well-being is not suitable for monitoring, because it is difficult to isolate the cause of economic changes "Transportation-related" can be interpreted as specific industries or the impact of projects on all industries 	<p>The current outcome definition may be too restrictive. Economic well-being is more suitable for forecasting than for monitoring. REMI can measure transportation system economic well-being, regardless of the indicator chosen. Interpreting "transportation-related" as applying to specific industries is limited and does not capture the full impact of the transportation system on the economy</p>	<ul style="list-style-type: none"> Use REMI to measure economic well-being Interpret "transportation-related" as all industries impacted by the transportation system Consider modifying definition to include "standard of living" With modified definition, apply three primary indicators: <ul style="list-style-type: none"> Gross Regional Product Employment Personal Income Analyze bundles of transportation investments at the State and regional level Do not include outcome in reports that monitor the transportation system

**THIS TECHNICAL MEMORANDUM PRESENTS THE PROOF-OF CONCEPT TESTING RESULTS
FOR THE ECONOMIC WELL-BEING OUTCOME**

- The memorandum discusses the definition of the economic well-being outcome and its implications
- The process for conducting economic well-being proof-of-concept testing is described
- Potential economic well-being indicators are identified and discussed
- The applicability of the REMI measurement framework is considered
- Two case studies demonstrate the application of economic well-being performance measures
- The conclusions of this effort are discussed

THE DEFINITION OF THE ECONOMIC WELL-BEING OUTCOME IS CHALLENGING TO INTERPRET

- Economic well-being is one of nine outcomes in the performance measurement initiative. The primary difficulty in testing economic well-being is interpreting the outcome defined by the policy committee and identifying an appropriate measurement framework
- In an earlier phase of the initiative, the governing policy committee defined the economic well-being outcome as “contributing to California’s economic growth”
- The Transportation Assessment Steering Committee (TASC), the internal working group at the time, suggested a candidate indicator described as:

The value of all transportation-related goods and services, regardless of industry origin, delivered to the final customer, and includes consumer and government expenditures, investments and net exports

- These definitions and the associated discussion (shown above) suggest multiple economic indicators that differ in whether they focus on producers, consumers, or the economy as a whole. For example, the definition of final demand provided by the TASC includes goods and services delivered to the final customer (consumption) as well as components of gross regional product (total economy), while the discussion for the candidate measure focuses on production
- The economic well-being of some individuals may be affected at the expense of others. Equity issues, such as income distribution, are the focus of the equity outcome, which is not included in the current proof-of-concept testing

DEFINITION OF ECONOMIC WELL-BEING OUTCOME PROVIDED BY POLICY COMMITTEE

OUTCOME: ECONOMIC WELL-BEING	
Definition	Contributing to California's economic growth
Discussion	This outcome seeks to monitor the share of transportation-related final demand in gross regional (or State) product.
Candidate Measures	Final Demand

CANDIDATE MEASURES: FINAL DEMAND	
Definition	Final demand is the value of all transportation-related goods and services, regardless of industry origin, delivered to the final customer, and includes consumer and government expenditures, investments and net exports.
Discussion	The measure will be used to monitor changes in transportation-related economic activity. It will also show if the transportation share of economic production is rising, declining, or maintaining its current levels.

ANOTHER CHALLENGE IS INTERPRETING THE CONCEPT OF "TRANSPORTATION-RELATED"

- The definition of the outcome includes the phrase "transportation-related." This phrase is also referenced in the definition and discussion for the candidate measure
- "Transportation-related" could be interpreted in two ways:
 - 1) Focus only on the industries that directly involve transportation
 - 2) Consider the impact of transportation projects on all industries and assume that any industry affected must be "transportation-related"
- The first definition requires "transportation-related" industries to be identified. A review of the Standard Industrial Classification (SIC) list of industries provides an initial set of potential "transportation-related" industries that are presented above
- As a later section on potential indicators shows, some of the measures considered can focus exclusively on these industries
- However, the industries may not adequately capture all of the industrial activity related to transportation (described further in the pages that follow)
- The internal working group also expressed reservations about the relevance of considering the well-being of only particular industries that are identified as "transportation-related"

TRANSPORTATION-RELATED INDUSTRIAL SECTORS

Motor Vehicle Manufacturing

Rest of Transportation Manufacturing

Petroleum Products

Railroads

Trucking

Local/Interurban Transportation

Air Transportation

Other Transportation

Automobile Repair Services

IF THE FIRST INTERPRETATION WERE ADOPTED, STANDARD INDUSTRIAL CLASSIFICATIONS MAY NOT CAPTURE ALL OF THE INDUSTRIAL ACTIVITY RELATED TO TRANSPORTATION

- At the 53-sector level of aggregation, nine industrial sectors relate directly to transportation. However, these sectors do not include the full range of transportation-related activity:
 - *Some activity is excluded.* For example, automobile insurance cannot be separated from general insurance
 - *In-house transportation is not included.* For instance, a logging company that hauls its own lumber, rather than hire a trucking company, is not included
 - *A small portion of non-transportation activity may be included.* For example, petroleum products can be used for heating rather than transportation
- The issue of in-house transportation may be resolved by using specialized tables, called Transportation Satellite Accounts, that identify transportation-related economic activity in non-transportation industries. These tables, developed jointly by the Bureau of Transportation Statistics (BTS) and the Bureau of Economic Analysis (BEA), are available
- The other two issues listed above involve the definition of industrial classifications but generally will not be resolved by the new North American Industrial Classification System (NAICS), which will replace SIC codes by 2002

THE WORKING GROUP RECOMMENDS THAT THE ECONOMIC WELL-BEING OUTCOME CONSIDER THE IMPACTS OF TRANSPORTATION PROJECTS ON ALL INDUSTRIES

THE ECONOMY IS INFLUENCED BY MANY SECTORS IN ADDITION TO TRANSPORTATION AND IT IS DIFFICULT TO ISOLATE THE CAUSE OF ECONOMIC CHANGES

- State or regional economic well-being can be influenced by a variety of factors other than transportation or transportation projects:
 - Health of the national economy
 - Currency fluctuations
 - Interest rates
 - Wage rates
 - Technological innovations
 - Investments in other regions
 - Other investments in the local region
 - Numerous other factors
- Regardless of the indicator(s) adopted, the measurement of economic well-being will be influenced by some or all of these factors
- The impacts of specific transportation improvements on economic well-being can be forecasted by assuming that these other factors remain unchanged by the improvements
- However, once transportation improvements are made, it is difficult to separate the impact of the improvements on the economy from the influence of the other factors, which change over time
- No method exists for separating the effects of transportation from other factors. It is nearly impossible to monitor changes in economic well-being attributable to transportation

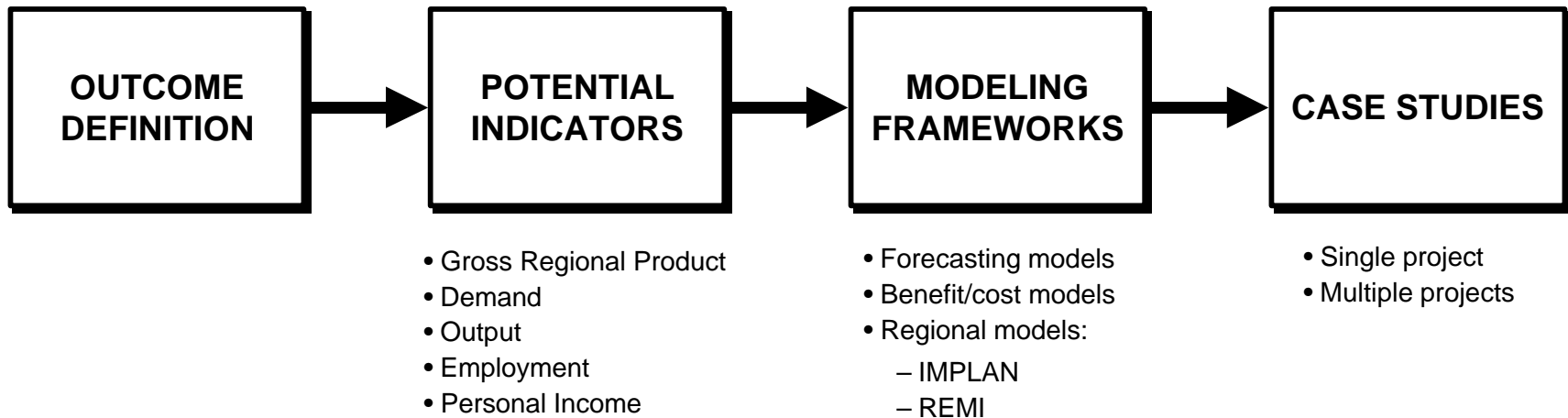
ECONOMIC WELL-BEING IS MORE SUITED FOR FORECASTING THAN FOR MONITORING

PROOF-OF-CONCEPT TESTING FOLLOWED DIRECTLY FROM THE INTERPRETATION OF THE DEFINITION FOR THE ECONOMIC WELL-BEING OUTCOME

- We began by identifying potential indicators that correspond to the interpretation of the outcome definition. Initially, three indicators were identified: gross regional product, demand, and output
- Based on feedback from the working group, two other indicators (employment and personal income) that meet an expanded definition of economic well-being were selected and tested. These two measures were chosen to capture the direct impacts on the standard of living for transportation users
- Once a set of measures were identified, we examined potential frameworks for forecasting changes in the indicators due to transportation projects. We considered three different frameworks and narrowed the options to a single framework
- After selecting an appropriate modeling framework, we examined specific models and chose the REMI model for further consideration
- The final step was to test the REMI model using two case studies: one to simulate a single transportation project and another to examine a group of transportation projects. The case studies also demonstrate how each of the recommended indicators can be measured and interpreted

THE SECTIONS THAT FOLLOW DESCRIBE EACH STEP OF THE PROCESS AND ITS FINDINGS

PROCESS FOR ECONOMIC WELL-BEING PROOF-OF-CONCEPT TESTING



WE INITIALLY TESTED THREE POTENTIAL INDICATORS SUGGESTED BY THE DEFINITION OF ECONOMIC WELL-BEING

- The economic well-being outcome is currently defined as “contributing to California’s economic growth”
- The discussion section of the definition states that the definition is intended to "monitor the share of transportation-related final demand in gross regional (or State) product." The appropriate indicator(s) should show "if the transportation share of economic production is rising, declining or maintaining"
- The discussion section and definition suggest three potential economic well-being indicators:
 - Gross Regional Product (GRP)
 - Demand
 - Output
- These indicators differ by whether they consider where value-added is created, where goods and services are purchased, or where goods and services are produced. Value-added measures the amount of economic value added to each product at every stage of its production. This concept avoids double counting and provides a measure of general economic activity

THE FOLLOWING PAGES DEFINE EACH INDICATOR AND DISCUSSES ITS ADVANTAGES AND DISADVANTAGES FOR MEASURING ECONOMIC WELL-BEING

GROSS REGIONAL PRODUCT CAPTURES ECONOMIC GROWTH ACROSS THE ENTIRE ECONOMY

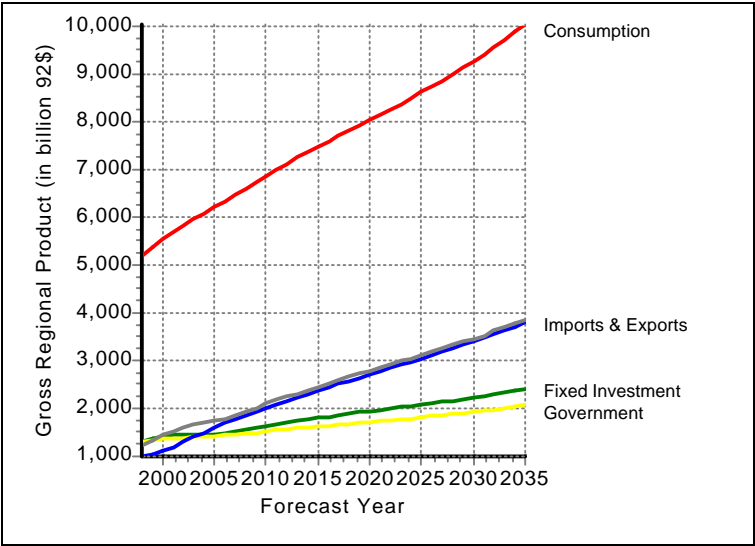
$$\text{Gross Regional Product} = \text{Consumption} + \text{Investment} + \text{Government Purchases} + \text{Net Exports (exports minus imports)}$$

- **Consumption** is expenditures by consumers within the region on durable goods, non-durable goods, and services
- **Investment** consists of fixed investment and inventories
- **Government purchases** include all purchases of goods and services by all levels of government within the region
- **Net exports** adjust for the fact that not all the goods and services bought within the region are produced within the region and not all goods produced within the region are bought within the region
- GRP can fit both interpretations of "transportation-related" (see page 3). The impact of transportation projects on GRP can be measured, and GRP related to the consumption of transportation goods and services can be identified. Consumption of transportation goods and services includes only purchases by households. It excludes government purchases, purchases by businesses (to produce other goods and services), and investment spending

THE GRP INDICATOR FOCUSES ON VALUE-ADDED PRODUCTION AND CAN MEASURE THE IMPACT OF TRANSPORTATION INVESTMENTS ON GENERAL ECONOMIC ACTIVITY

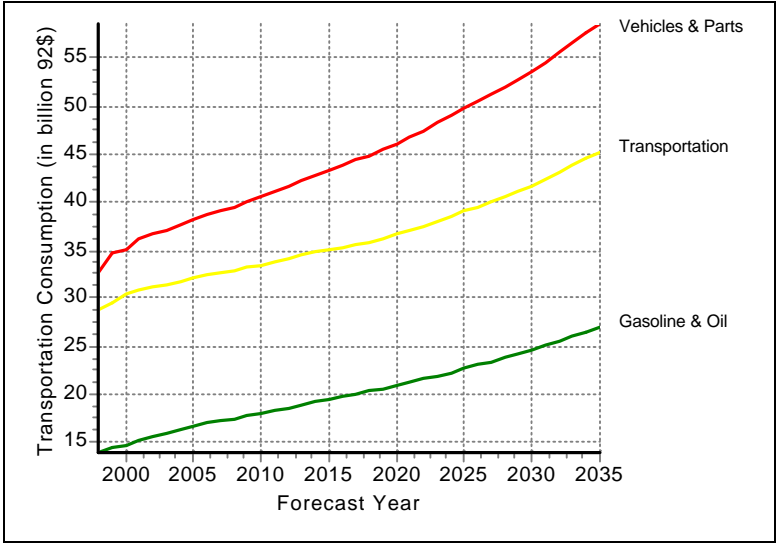
GROSS REGIONAL PRODUCT

Statewide Gross Regional Product (GRP)



Source: REMI Policy Insight Model

Transportation-Related Consumption
Components of Statewide GRP



Source: REMI Policy Insight Model

GRP MEASURES THE ECONOMIC HEALTH OF THE REGION BUT IT CAN BE INFLUENCED BY A VARIETY OF OTHER FACTORS

Advantages

1. GRP includes all goods and services produced within a region and is a commonly accepted measure of a region's general economic health
2. Since it excludes the purchases of goods and services produced elsewhere, GRP focuses on the economic value generated inside the region, which reflects local "economic growth"
3. The impact of transportation projects on GRP can be forecasted

Disadvantages

1. Transportation-related consumption can be identified separately, but this measure includes only purchases by consumers, while ignoring purchases by the government and businesses

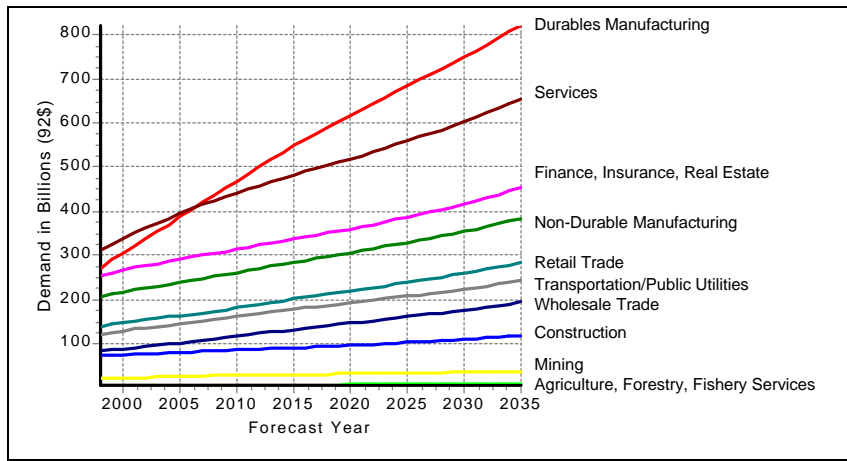
GRP MORE CLOSELY MEETS THE CRITERIA OF THE ECONOMIC WELL-BEING OUTCOME AS DEFINED BY THE POLICY COMMITTEE

DEMAND REFLECTS THE VALUE OF ALL GOODS AND SERVICES CONSUMED WITHIN A REGION

- Demand refers to the value of goods and services purchased by consumers and the government, including imports, within a particular region (or the State). This indicator can be summed for the entire region or broken down by industry
- Like GRP, the demand indicator can meet either interpretation of "transportation-related"
- Demand can be identified separately for several transportation-related industrial sectors:
 - Motor Vehicle Manufacturing
 - Rest of Transportation Manufacturing
 - Petroleum Products
 - Railroads
 - Trucking
 - Local/Interurban Transportation
 - Air Transportation
 - Other Transportation
 - Automobile Repair Services
- The total demand for these sectors approximates the transportation share of goods and services purchased
- The impact of transportation projects on total demand can also be forecasted

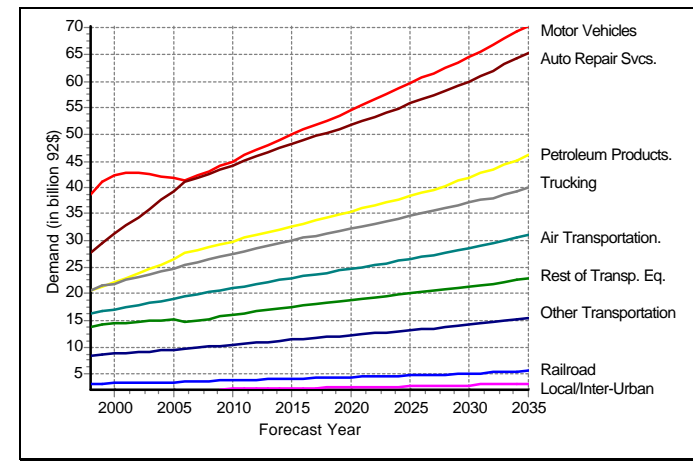
DEMAND

Total Statewide Demand



Source: REMI Policy Insight Model

Demand in Transportation-Related Industries



Source: REMI Policy Insight Model

DEMAND FOCUSES ONLY ON CONSUMPTION AND INCLUDES GOODS AND SERVICES PRODUCED OUTSIDE OF CALIFORNIA

Advantages

1. Demand measures the value of all goods and services purchased within the region, regardless of the purchaser, and includes both consumers and the government
2. Demand for the output of transportation-related industries can be separated from goods and services produced by other industries
3. The impact of transportation projects on demand can also be forecasted

Disadvantages

1. Demand includes imports, since regional demand can be satisfied by production originating anywhere
2. Demand does not capture economic activity (production) associated with meeting external demand
3. Even if demand by California consumers and the government is satisfied by California production alone (i.e., no imports to the state to meet demand), the economic value-added could be generated elsewhere, since producers may continue to import their intermediate goods and service

DEMAND ALONE IS A POOR INDICATOR FOR ECONOMIC WELL-BEING, SINCE IT INCLUDES IMPORTS, EXCLUDES EXPORTS, AND IGNORES PRODUCTION

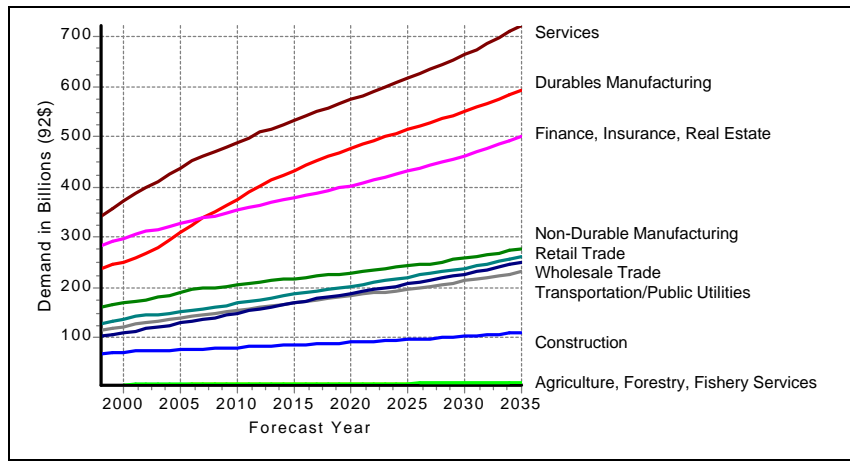
THE THIRD CANDIDATE INDICATOR, OUTPUT, FOCUSES ON PRODUCTION RATHER THAN CONSUMPTION

- Output refers to the value of all goods and services produced by the regional (or State) economy, including exports
- Similar to demand, output can be used as an indicator for either interpretation of "transportation-related"
- Output can be identified for several transportation-related industries:
 - Motor Vehicle Manufacturing
 - Rest of Transportation Manufacturing
 - Petroleum Products
 - Railroads
 - Trucking
 - Local/Interurban Transportation
 - Air Transportation
 - Other Transportation
 - Automobile Repair Services
- The total output of these industries approximates the transportation share of goods and services produced. The impact of transportation projects on output, regardless of industry, can also be measured

OUTPUT CAN BE USED TO FORECAST IMPACTS ON INDUSTRIES RATHER THAN CONSUMERS

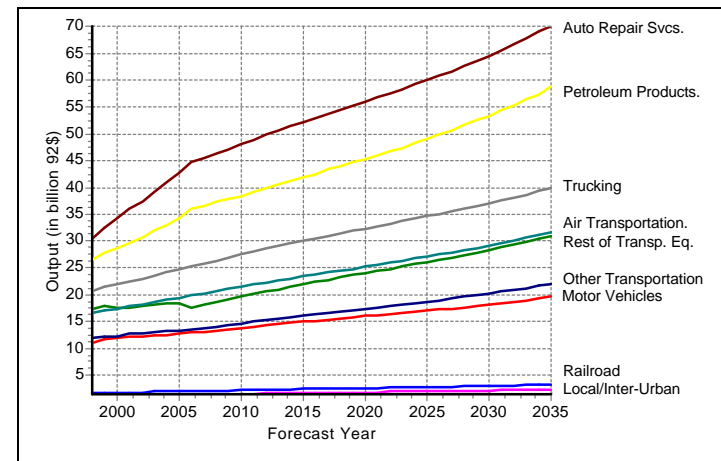
OUTPUT

Total Statewide Output



Source: REMI Policy Insight Model

Output in Transportation-Related Industries



Source: REMI Policy Insight Model

OUTPUT FOCUSES ONLY ON PRODUCTION AND DOES NOT NECESSARILY CAPTURE THE NEEDS OF CALIFORNIA CONSUMERS

Advantages

1. Output measures all production occurring within the region, including exports
2. Output can be identified separately for transportation-related industries
3. The impact of transportation projects on output can also be measured

Disadvantages

1. The final customer for goods and services produced within California may be located outside California, so California residents do not necessarily benefit
2. Output does not necessarily capture all of the economic activity associated with meeting internal (California) demand
3. Although output measures the value of goods and services produced in the region, the value-added production could occur somewhere else

OUTPUT ALONE IS A POOR INDICATOR FOR ECONOMIC WELL-BEING, SINCE IT INCLUDES EXPORTS, EXCLUDES IMPORTS, AND IGNORES CONSUMPTION

OF THE THREE INDICATORS TESTED, GROSS REGIONAL PRODUCT COMES CLOSEST TO MEASURING THE ECONOMIC WELL-BEING OUTCOME AS CURRENTLY DEFINED

- Gross Regional Product measures all goods and services produced within a region and is a commonly accepted measure of a region's general economic health. Since it excludes the purchases of goods and services produced elsewhere, gross regional product reflects local "economic growth"
- Demand and output are not as useful for measuring the impact of transportation investments from the perspective of the transportation system user
- All three indicators can meet either interpretation of "transportation-related"
- On the basis of these findings, the initial suggestion was that economic well-being be measured by gross regional product alone or in combination with the other two measures
- Upon further consideration and feedback from external review, the Working Group asked that two additional candidate indicators be considered – employment and personal income
- Employment and personal income measure aspects of economic well-being that directly concern California residents. Since the indicators are commonly used and reported in the media, they are easily understood by the public and policy makers. However, these indicators do not meet the criteria of the current outcome definition

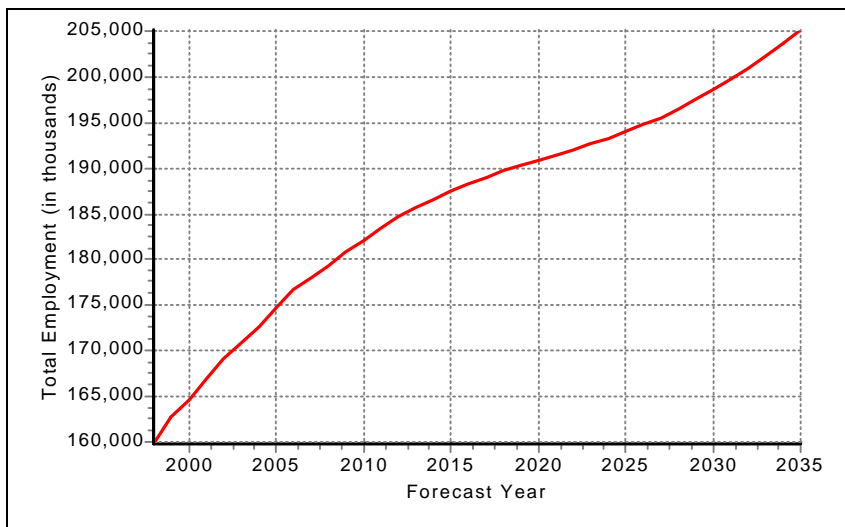
THE FOLLOWING PAGES CONSIDER IN MORE DETAIL THE IMPLICATIONS OF INCLUDING EMPLOYMENT AND PERSONAL INCOME INDICATORS FOR ECONOMIC WELL-BEING

EMPLOYMENT PROVIDES A MEASURE OF THE STANDARD OF LIVING FOR AREA RESIDENTS

- Employment is an economic health measure frequently reported in the press and readily understood by the public. High employment generally reflects a good economy and suggests a relatively good quality of life for area residents
- Employment can be measured in terms of people or jobs. The Bureau of Economic Analysis uses a "place of work" concept that measures the number of jobs. This measurement includes both full-time workers. Since individuals can hold more than one job, they may be counted more than once
- Employment can be further identified by sector (i.e., government, farm, or non-farm) or by source of demand (i.e., local consumption, government demand, investment activity, exports, or intermediate consumption)
- Transportation infrastructure projects may affect employment immediately by creating jobs. Projects, such as the construction of a new transit facility or the widening of a highway, employ construction workers and others who manufacture the components needed to construct the facility. These workers require food, clothing, shelter, entertainment, etc., which creates additional jobs
- Transportation can also increase employment by improving productivity through lower shipping costs and reduced travel times, which has an additional positive effect on employment by increasing the desirability of the region for employers

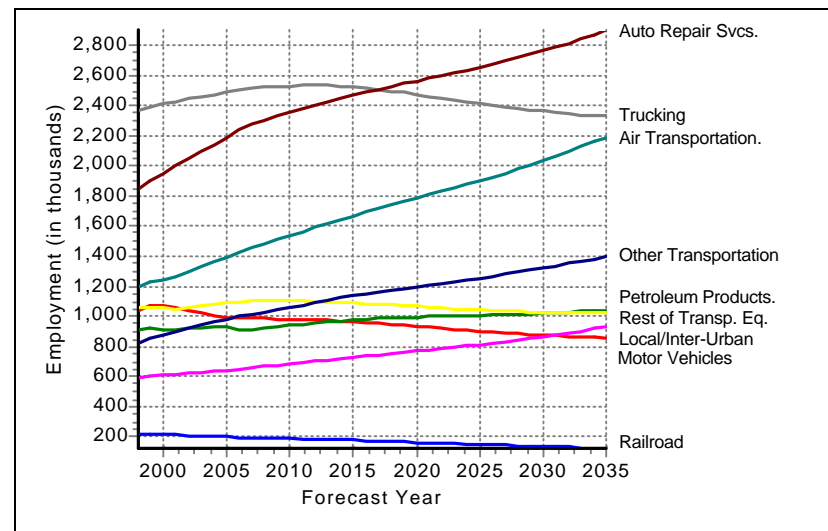
EMPLOYMENT

Total Statewide Employment



Source: REMI Policy Insight Model

Employment in Transportation-Related Industries



Source: REMI Policy Insight Model

EMPLOYMENT PROVIDES A MEASURE OF ECONOMIC HEALTH, BUT DOES NOT DIRECTLY CORRESPOND TO THE EXISTING DEFINITION OF ECONOMIC WELL-BEING

Advantages

1. Decision-makers and the public understand employment as a measure of economic health
2. Employment in transportation-related industries can be separated from total employment
3. The impact of transportation projects on total employment can be modeled

Disadvantages

1. Employment does not directly meet the economic well-being outcome definition provided by the policy committee – "contributing to economic growth" – and the associated discussion
2. Adoption of the indicator would require the policy committee to modify the outcome definition

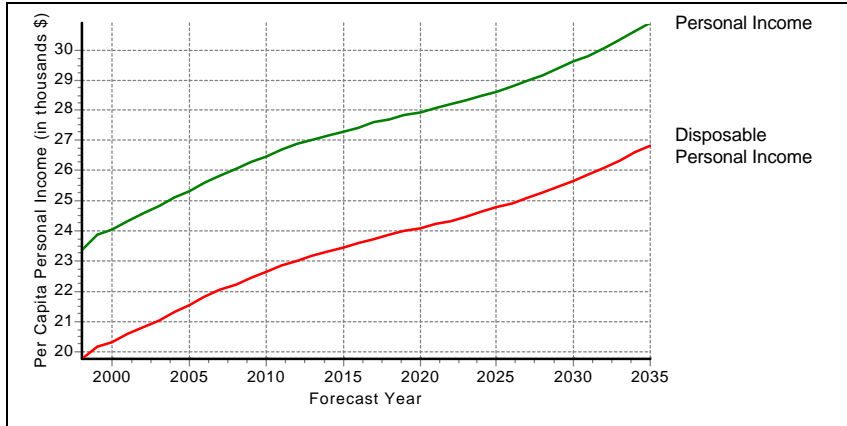
THE ECONOMIC WELL-BEING OUTCOME SHOULD INCLUDE THE EMPLOYMENT INDICATOR, IF THE OUTCOME WERE MODIFIED TO INCLUDE "STANDARD OF LIVING"

PERSONAL INCOME IS ANOTHER COMMONLY USED MEASURE OF ECONOMIC HEALTH IN TERMS OF STANDARD OF LIVING

- Personal income is defined as the total income received by the public before income taxes. If transportation changes personal income, it also affects a person's ability to purchase food, clothing, housing, and other desired goods and services
- The BEA measures personal income using a "place of residence" concept. Personal income is calculated as: the sum of wage and salary disbursements, other labor income, proprietors' income, rental income, personal dividend income, personal interest income, and transfer payments minus personal contributions of social insurance
- Economists frequently rely on disposable personal income to measure standard of living. Disposable personal income, excludes taxes from personal income and provides a better measure of the money available to the public for consumption and savings
- Often this indicator is adjusted by the price index (i.e., presented in real terms) to take into account the effect of inflation and expressed in per capita terms
- Transportation can affect personal income by creating higher paying jobs and by increasing productivity. Employers can return productivity increases to shareholders as dividends and employees as higher salaries
- A personal income indicator can fulfill either interpretation of "transportation-related." It can be calculated in terms of either the impact of transportation projects on personal income in all industries or wage and salary income for transportation industries

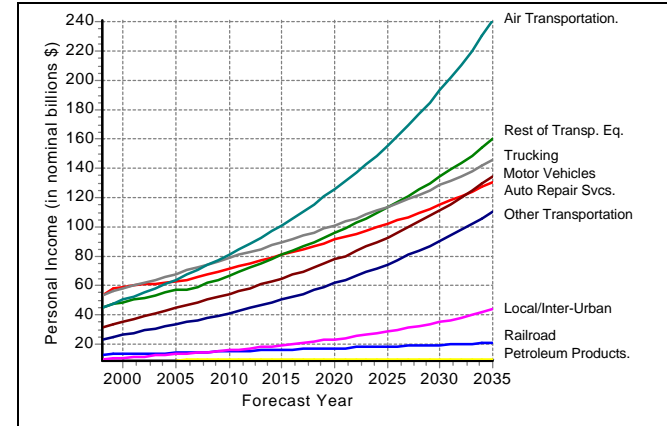
PERSONAL INCOME

Real Per Capita Personal Income



Source: REMI Policy Insight Model

**Total Wage and Salary Personal Income
In Transportation-Related Industries**



Source: REMI Policy Insight Model

PERSONAL INCOME IS THE MEASURE THAT MOST DIRECTLY CAPTURES THE STANDARD OF LIVING EXPERIENCED BY THE EMPLOYED PUBLIC

Advantages

1. Personal income directly measures the standard of living experienced by employed individuals and is readily understood by decision makers
2. The impact of transportation projects on personal income, regardless of employer, can be forecasted

Disadvantages

1. The personal income provided by transportation industry employers can also be calculated separately, but this measure only includes wage and salary income
2. Personal income measures standard of living, rather than "contributing to economic growth"
3. Adoption of the indicator would require the policy committee to modify the outcome definition

THE ECONOMIC WELL-BEING OUTCOME SHOULD INCLUDE THE PERSONAL INCOME INDICATOR, IF THE OUTCOME WERE MODIFIED TO INCLUDE "STANDARD OF LIVING"

WE SUGGEST THAT MULTIPLE INDICATORS BE USED TO MEASURE ECONOMIC WELL-BEING AND THAT THE POLICY COMMITTEE CONSIDER MODIFYING THE DEFINITION SLIGHTLY

- Gross regional product continues to be the indicator that comes closest to matching the current definition of the economic well-being outcome
- The current definition does not appear to capture fully the impact on people/households, who are the ultimate consumers of transportation systems. We propose that the policy committee consider modifying the definition of the economic well-being outcome as follows:

"Contributing to California's economic growth and standard of living"

- This definition suggests two new indicators that measure the "standard of living" for California residents:
 - Employment
 - Personal income
- These new indicators are customer-focused and easy-to-understand. In addition, they reflect criteria that policy makers frequently consider in decision making
- The three recommended indicators (gross regional product, employment, and personal income) can be supplemented by outcome and demand

THE NEXT SECTION PRESENTS THE INVESTIGATION OF APPROPRIATE MEASUREMENT FRAMEWORKS AND REMI, WHICH CAN BE USED TO CALCULATE ALL FIVE INDICATORS

FIVE POTENTIAL INDICATORS FOR ECONOMIC WELL-BEING

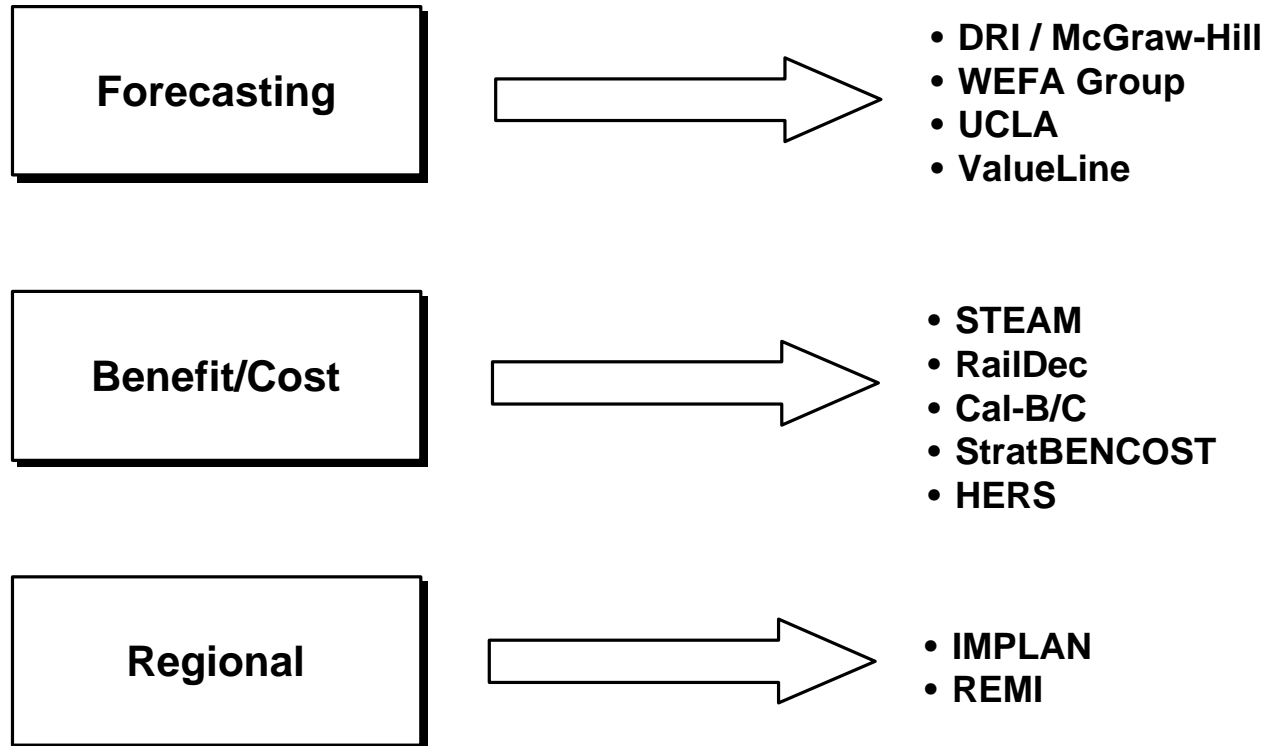
INDICATOR	DEFINITION	ADVANTAGES	DISADVANTAGES	
Gross Regional Product (GRP)	Total spending on goods & services produced within region	<ul style="list-style-type: none"> • Focuses on economic value generated in region • Measures general economic health of region 	<ul style="list-style-type: none"> • Is hard to separate for transportation-related industries 	RECOMMENDED
Employment	Number of full-time & part-time employees in region	<ul style="list-style-type: none"> • Measures economic health & is easily understood • Meets both interpretations of transportation-related 	<ul style="list-style-type: none"> • Does not fit current definition of economic well-being 	
Personal Income	Total earnings from wages, passive enterprises, investment interest & dividends for individuals in region	<ul style="list-style-type: none"> • Measures standard of living & is easily understood 	<ul style="list-style-type: none"> • Does not fit current definition of economic well-being • Includes only wage & salary when calculated for only transport-related industries 	
Demand	Value of all goods & services purchased within region	<ul style="list-style-type: none"> • Measures regional demand for goods & services • Meets both interpretations of transportation-related 	<ul style="list-style-type: none"> • Includes imports, but excludes exports • Does not measure economic value generated in region 	SUPPLEMENTAL
Output	Value of all goods & services produced within region	<ul style="list-style-type: none"> • Measures regional production, including exports • Meets both interpretations of transportation-related 	<ul style="list-style-type: none"> • Includes non-California consumers • Does not measure economic value generated in region 	

BOOZ-ALLEN CONSIDERED THREE DIFFERENT MEASUREMENT FRAMEWORKS FOR FORECASTING ECONOMIC WELL-BEING INDICATORS

- Booz-Allen examined three potential frameworks to determine their suitability for measuring economic well-being and found that:
 - Forecasting models are useful for predicting changes in general economic indicators, but not for measuring economic impacts of transportation investments
 - Benefit/cost models are suitable for measuring the cost-effectiveness of potential investments, but not for measuring their impacts on final demand
 - Regional models are the most suitable for measuring economic well-being, as they forecast economic impacts on the regional economy. These models focus on regional effects and economic relationships across industries
- We considered the capabilities of two commercially-available regional models: REMI and IMPLAN. REMI was found to be more suitable for forecasting economic well-being indicators, since it models the multiplier effect of transportation investments on economic well-being and accounts for increases in industrial productivity due to these investments
- Case studies were developed and analyzed using the REMI model to test its capabilities further. These case studies are discussed later in the report

THE NEXT TWO PAGES REVIEW THE RESULTS OF THE INITIAL FRAMEWORK TESTING IN MORE DETAIL

FRAMEWORKS CONSIDERED FOR MEASURING ECONOMIC WELL-BEING



WE FOUND THAT REGIONAL MODELS ARE THE MOST APPROPRIATE FRAMEWORK FOR FORECASTING ECONOMIC WELL-BEING INDICATORS

MODELS	FINDINGS	CONCLUSIONS	RECOMMENDATIONS
Forecasting	<ul style="list-style-type: none"> Forecasting models are useful as broad predictors of changes in general economic indicators, such as unemployment and inflation However, it is difficult to tailor forecasting models to specific investments 	Forecasting provides useful predictions of future economic conditions, but cannot measure system performance	<ul style="list-style-type: none"> Evaluate other economic models for measuring economic well-being
Benefit/Cost	<ul style="list-style-type: none"> Benefit/cost models can estimate many transportation impacts (e.g., travel times, operating costs, etc.) However, benefit/cost models focus on direct benefits and costs, rather than impacts on the state or regional economy (e.g., gross state or regional product) 	Benefit/cost models are more appropriate for measuring cost-effectiveness than economic well-being	<ul style="list-style-type: none"> Evaluate other economic models for measuring economic well-being Consider using benefit/cost models to measure cost effectiveness
Regional	<ul style="list-style-type: none"> Regional models can analyze, through purchases and employment, the economic impact of transportation investments However, these models cannot fully capture final demand if some transportation services and equipment manufacturing occur outside transportation-related industries 	Regional models can forecast the impacts of transportation investment on the regional economy. REMI is more suitable than IMPLAN for measuring economic well-being	<ul style="list-style-type: none"> Test the applicability of the REMI model for performance measurement

AFTER CONSIDERING TWO POTENTIAL REGIONAL MODELS, WE FOUND REMI TO BE MORE APPROPRIATE FOR MEASURING ECONOMIC WELL-BEING

REGIONAL MODEL	FINDINGS	CONCLUSIONS	RECOMMENDATIONS
IMPLAN	<ul style="list-style-type: none"> • IMPLAN is based upon an input-output framework. It considers direct, indirect, and "induced" effects by examining industry transactions • It can generate five measures of regional economic activity: <ul style="list-style-type: none"> – Value added – Total industry output – Personal income – Total income – Employment 	IMPLAN can measure the multiplier effect of transportation investment on economic well-being, but <u>cannot</u> measure productivity gains	<ul style="list-style-type: none"> • Examine alternative regional input-output models
REMI	<ul style="list-style-type: none"> • REMI supplements input-output framework with econometric models, which account for business cycles and add flexibility in timing economic impacts • Users may change economic policy variables to simulate impacts • REMI can be calibrated to regional and state economic conditions 	REMI can measure the multiplier effect of transportation investment on economic well-being, and <u>can</u> measure productivity gains	<ul style="list-style-type: none"> • REMI is the most appropriate model for monitoring economic well-being • Conduct case studies to test REMI further for its use in performance measurement

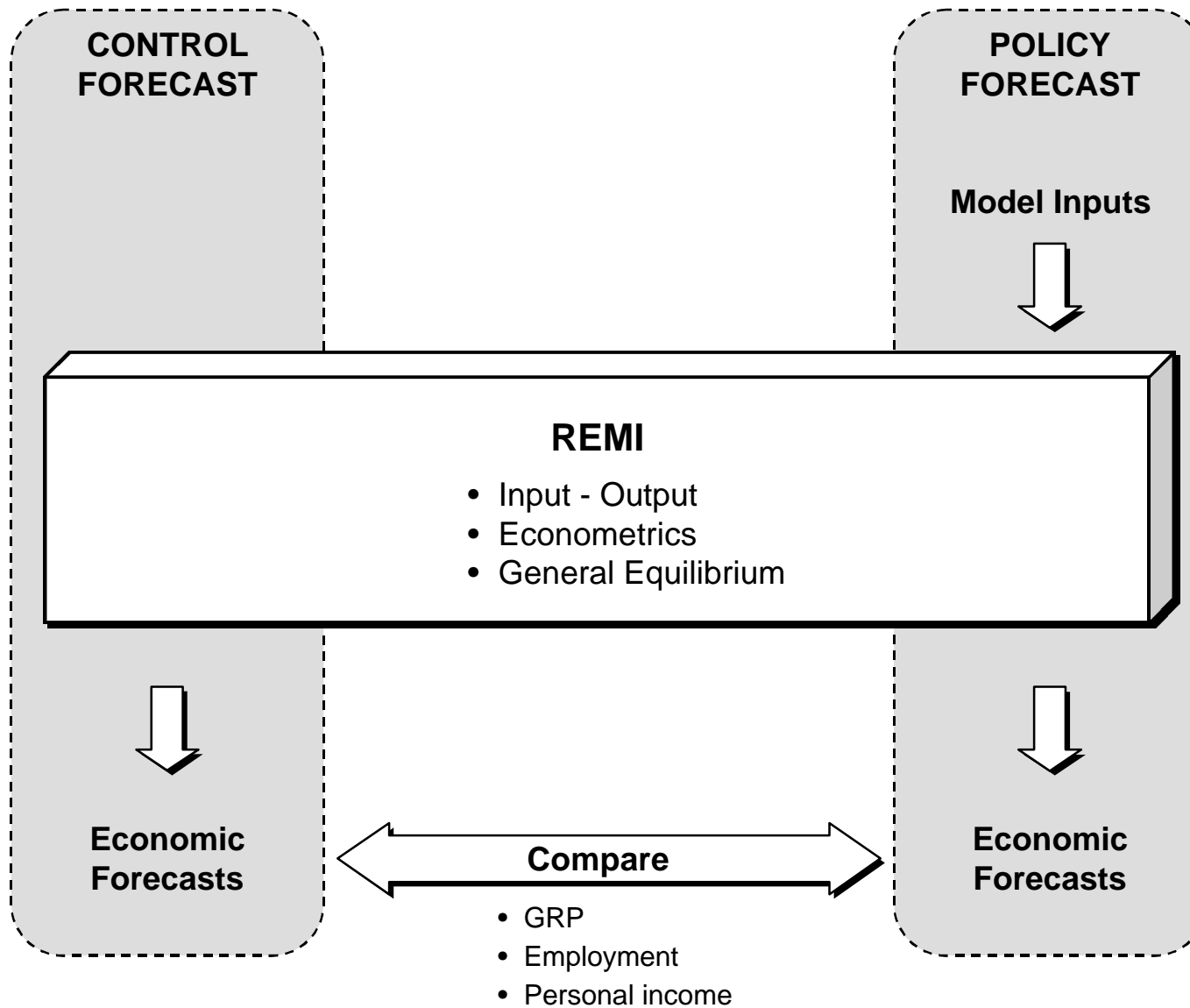
THE REMI MODEL IS CAPABLE OF MEASURING IMPACTS OF TRANSPORTATION PROJECTS ON ECONOMIC WELL-BEING DUE TO INVESTMENTS AND PRODUCTIVITY GAINS

REMI SIMULATES THE REGIONAL ECONOMY USING A COMBINATION OF INPUT-OUTPUT, ECONOMETRIC, AND GENERAL EQUILIBRIUM TECHNIQUES

- REMI forecasts the effect of transportation investments by comparing the results of a policy/build forecast (what happens if investment is made) to those of a control/no-build forecast
- The control forecast predicts what the economy will be like in the future if the project is not built. REMI develops custom forecasts for each model using annual data from a variety of sources. The data come primarily from:
 - BEA Regional Employment and Income Series
 - University of Michigan Two-Year Forecasts
 - BEA Output and Employment Forecasts by Industry
 - US Census Projections
- The level of industrial detail and the number of regions to include can be customized so REMI can measure economic well-being at the state or regional level. If multiple regions are modeled, the impact of transportation investments in one region on economic well-being in another region can also be considered
- REMI produces output for over a thousand economic measures, including all five potential indicators considered for the economic well-being outcome

REMI MEASURES THE ECONOMIC IMPACT OF TRANSPORTATION PROJECTS BY COMPARING A POLICY FORECAST TO A CONTROL FORECAST

CALCULATING ECONOMIC WELL-BEING

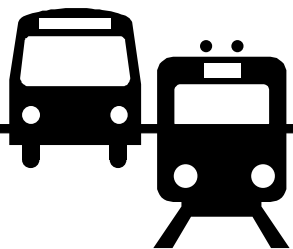


CALCULATING ECONOMIC WELL-BEING REQUIRES DATA FOR DIFFERENT POLICY VARIABLES THAT SERVE AS INPUTS TO THE MODEL

- *Construction and Construction Financing* – This reflects increased spending in the construction industry due to expenditures for the project and project financing as reflected in adjusted tax rates or reduced government expenditures in other areas
- *Public Transportation* – Public transit projects increase employment in the Inter-Urban Transport sector, reduce consumer expenditures on other types of transportation, and increase taxes to pay operating subsidies to the extent that local funding sources are used
- *Environmental Impacts* – Environmental impacts are modeled as changes in local amenities (factors that effect quality of life) and must be estimated externally using a tool, such as California Air Resources Board EMFAC7 or Caltrans Cal-B/C
- *Tourism* – REMI captures tourism impacts through the number of visitor days and default tourist expenditures (can be changed) by industry
- *Business Savings* – The effect of transportation investments on business costs depends on which modes are improved and reflect trucking/railroad costs and productivity
- *Commuter Savings* – Commuters may experience reductions in accident costs, travel time, and vehicle operating costs. These must be measured externally and are modeled as local amenities

REMI TRANSLATES THESE INPUTS INTO REGIONAL ECONOMIC IMPACTS AND FORECASTS CHANGES IN ECONOMIC INDICATORS, INCLUDING THE FIVE UNDER CONSIDERATION

**Public
Transportation**



Savings

**Business
Savings**

Environmental Impacts



Tourism



THE REMI MODEL IS CAPABLE OF FORECASTING EACH OF THE PROPOSED INDICATORS, BUT SOME PARTS OF THE MODELING CAN BE COMPLICATED

- Although REMI requires specialized economic knowledge for developing the policy variable inputs, running the model, and interpreting the outputs, REMI has been used by other transportation agencies, such as the Washington State Department of Transportation and the Los Angeles County Metropolitan Transportation Commission (LACMTA), to measure economic impacts
- REMI can require inputting multiple policy variables, and some variables may be unavailable. LACMTA has addressed the issue of inputting policy variables by developing a front-end interface that takes required REMI inputs directly from the regional travel demand model
- In addition external models may be required to develop the appropriate policy variables, but these models already exist and are available to Caltrans and other transportation agencies
 - Environmental impacts should be estimated using EMFAC7 or a comparable environmental model. EMFAC7 tables are incorporated into the ITMS tool
 - User benefits can be estimated using a computerized benefit-cost model, such as the existing Caltrans Cal-B/C model
- To account for in-house transportation, adjustments need to be calculated using the Transportation Satellite Accounts, which have already been developed by BTS and BEA

A NUMBER OF CALIFORNIA TRANSPORTATION AGENCIES ALREADY USE REMI

TO TEST THE APPLICABILITY OF REMI FOR MEASURING ECONOMIC WELL-BEING, WE RAN THE REMI MODEL FOR TWO HYPOTHETICAL CASE STUDIES BASED ON ACTUAL PROJECTS

- The case studies were chosen to represent different levels of investment in order to measure the sensitivity of the three potential indicators to transportation investments
 - The first case study shows the impact of the construction of a single intermodal facility on the California economy
 - The second case study measures the impact of a group of transportation investments on the California economy
- For both case studies, the policy (build) forecasts were compared to the control (no build) forecasts using a two-digit Standard Industrial Classification (SIC) model for California
- Appropriate inputs to the model were developed based on actual case studies provided by REMI. The number and type of inputs depend on the specific transportation projects contained in each case study, but the inputs fit into the six categories of policy variables described earlier
- Economic impacts were forecasted from 2002 to 2035 for the three primary economic well-being indicators being recommended:
 - Gross regional product
 - Total employment
 - Real personal income

THE FIRST CASE STUDY ILLUSTRATES THE IMPACT OF A SINGLE INTERMODAL PROJECT INVOLVING RAILROADS AND SHIPS

- The first case study shows the economic impact of a \$55 million (in 1992 dollars) project to construct an intermodal facility that serves railroads and ships
- This project was modeled using California as a single region. In effect, this treated the hypothetical facility as being constructed anywhere in California
- An actual project would be modeled as occurring in a specific region
- The economic impact of this project is felt primarily in the construction industry in the first few years and in the shipping and rail industries in later years. This cycle is typical of a project that facilitates goods movement

WE MEASURED THE IMPACT OF THIS PROJECT ON GRP, EMPLOYMENT, AND PERSONAL INCOME

POLICY VARIABLES CONSIDERED IN INTERMODAL FACILITY CASE STUDY

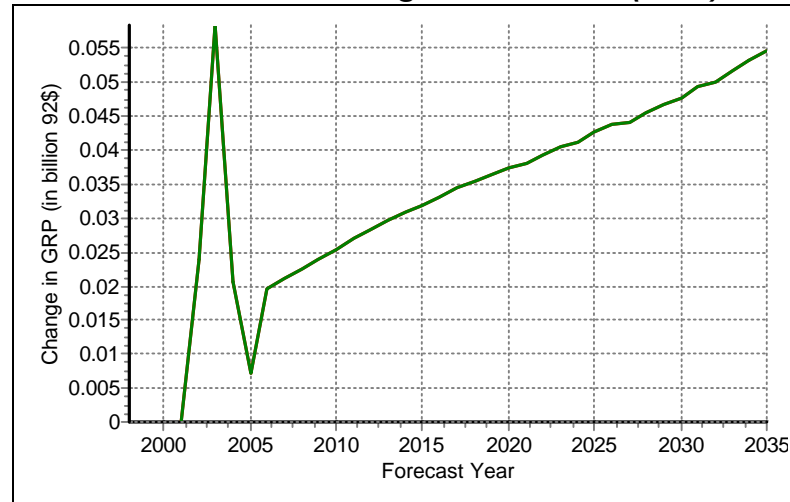
VARIABLE	DETAIL	UNIT
Construction Sales (amount)	New Local Transit Facilities	1992 US \$ (M)
Construction Sales (amount)	Maintenance and Repair Construction	1992 US \$ (M)
Other Transportation Sales (amount)	Miscellaneous Transportation Services	1992 US \$ (M)
State and Local Government Spending (amount)	Water and Air Facilities	1992 US \$ (M)
Production Cost (share)	Railroad	Percent
Production Cost (share)	Other Transportation	Percent
Production Cost (amount)	Other Transportation	1992 US \$ (M)

CONSTRUCTION OF THE INTERMODAL FACILITY PRODUCES A BOOM-AND-BUST CYCLE

- The graphs above show the impact of constructing the intermodal facility on statewide GRP, employment, and personal income. These impacts are shown net of what would have occurred had the project not been build. (Results for each indicator are shown as the policy forecast minus the control forecast)
- The change in statewide GRP summarizes the economic impacts. An initial spike occurs due to construction followed by a drop due to completion of the project. In later years, statewide GRP increases as California businesses become more productive and/or non-California business become more likely to relocate to California. REMI is unable to separate these two effects
- The impacts on employment growth as similar to those on statewide GRP. Employment spikes during the construction of the intermodal facility followed by a slight bust once the construction is completed and then longer term growth. The longer term growth reflects job creation due to increases in productivity and non-California business relocating to California
- Real personal income shows a similar pattern. Personal income rises as the project is constructed, but falls slightly after project completion. Personal income begins to rise again as the transportation project affects productivity and business share their increased wealth with employees
- Similar graphs can be produced to show the effect of the project on demand and output

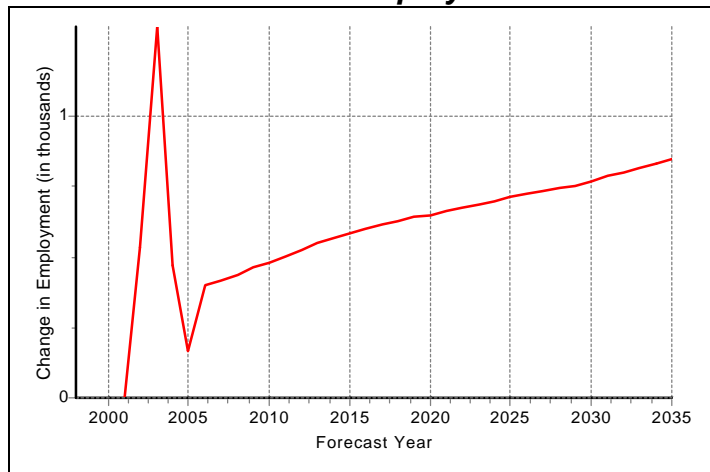
CHANGE IN ECONOMIC INDICATORS DUE TO CONSTRUCTION OF INTERMODAL FACILITY

Statewide Gross Regional Product (GRP)



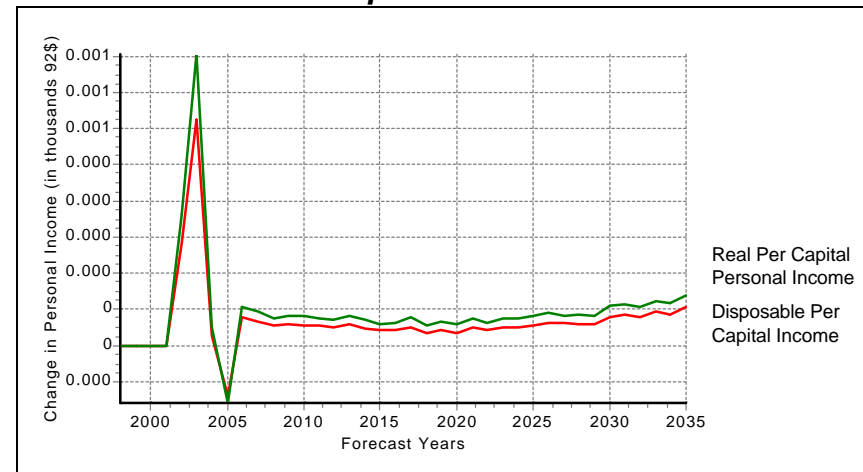
Source: REMI Policy Insight Model

Statewide Employment



Source: REMI Policy Insight Model

Real Per Capita Personal Income



Source: REMI Policy Insight Model

THE SECOND CASE STUDY ILLUSTRATES THE ECONOMIC IMPACT OF A GROUP OF TRANSPORTATION PROJECTS

- The second case study considered the impact of multiple transportation projects, which is roughly equal to the 1998 State Transportation Improvement Program (STIP) Augmentation Cycle in size and composition
- Total statewide construction costs for all projects included total \$675 million (in 92 dollars) spent over a six-year period beginning in 2002
- The investment program includes several different transportation modes, which have varying impacts on the economy:
 - Intercity Highway (25 percent of total investment) – primarily benefits trucking industry
 - Urban Highway (37.5 percent) and Local Roads (30 percent) – impacts commute travel and the trucking industry
 - Bus Transit (2.5 percent) – impacts commute travel
 - Intercity Rail (5 percent) – primarily benefits rail industry
- The modeling also took into account the impact of in-house trucking using the Transportation Satellite Accounts developed by BTS and BEA. As with the previous case study, economic impacts were estimated from 2002 to 2035

SELECTED POLICY VARIABLES CONSIDERED IN MULTIPLE PROJECT CASE STUDY*

INVESTMENT TYPE/VARIABLE	DETAIL	UNIT
Intercity Highway		
Construction Sales (amount)	New Roads	1992 US \$ (M)
State and Local Government Spending (amount)	Highways	1992 US \$ (M)
Production Cost (amount)	Trucking	1992 US \$ (M)
Non-Pecuniary (Amenity) Aspects (amount)	Labor Force and Dependents	1992 US \$ (M)
Consumer Spending by Residents (amount)	Vehicles and Parts	1992 US \$ (M)
Consumer Spending by Residents (amount)	Gasoline and Oil	1992 US \$ (M)
Consumer Spending by Residents (amount)	Medical Care	1992 US \$ (M)
Consumption Reallocation by Residents (amount)	All Consumption Sectors	1992 US \$ (M)
Government Spending (amount)	State and Local	1992 US \$ (M)
<i>Production Cost (amount)</i>	<i>Other Industries (allocated by BTS/BEA data)</i>	<i>1992 US \$ (M)</i>
Urban Highway		
Construction Sales (amount)	New Roads	1992 US \$ (M)
State and Local Government Spending (amount)	Highways	1992 US \$ (M)
Production Cost (amount)	Trucking	1992 US \$ (M)
Non-Pecuniary (Amenity) Aspects (amount)	Labor Force and Dependents	1992 US \$ (M)
Consumer Spending by Residents (amount)	Vehicles and Parts	1992 US \$ (M)
Consumer Spending by Residents (amount)	Gasoline and Oil	1992 US \$ (M)
Visitor Days	Hotel or Motel	Thousands
Visitor Dava	Rent Apartment or Home	Thousands

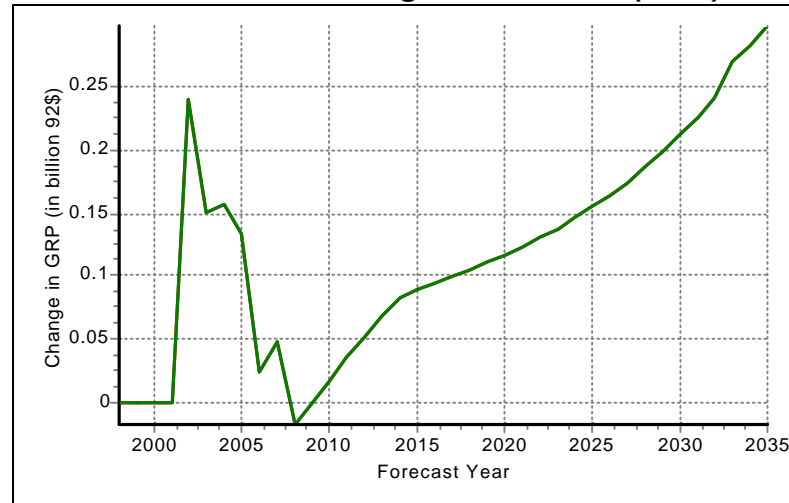
* Over 60 policy variables were considered for the five types of projects – only a portion is shown.

THE ECONOMIC IMPACTS REFLECT THE TIMING OF THE CONSTRUCTION PROJECTS AND MAY NOT ALWAYS BE POSITIVE

- As in the first case study an initial spike in statewide GRP is followed by a slight decline as construction ends. The decline has a stair-stepped quality because each transportation investment requires a different length of construction. As before, GRP increases in later years as California productivity improves and non-California businesses chose to relocate
- The effect on employment mimics that for statewide GRP. Employment grows by several thousand as a result of the construction effort. As construction ends on each transportation project, employment drops. After the completion of all the construction projects, employment begins to grow again compared to the no-build scenario as productivity improvements lead to job creation and attract businesses to California
- Real personal income illustrates that changes in economic indicators may not always be positive and that the indicators do not need to show the same changes. The graph above shows real personal income on a per capita basis. While personal income initially rises as a result of the infrastructure construction, personal income later falls. This may be due to the creation of relatively lower paying jobs. Although personal income falls on a per capita basis, total personal income (not shown) rises after the initial post-construction drop
- Similar graphs can be produced for demand and output, which show that economic impacts generally reflect the modes that primarily benefit. For example, the majority of the transportation investment was in highway projects. The largest increases in demand occur in the petroleum and automobile manufacturing sectors until highway congestion constrains travel demand

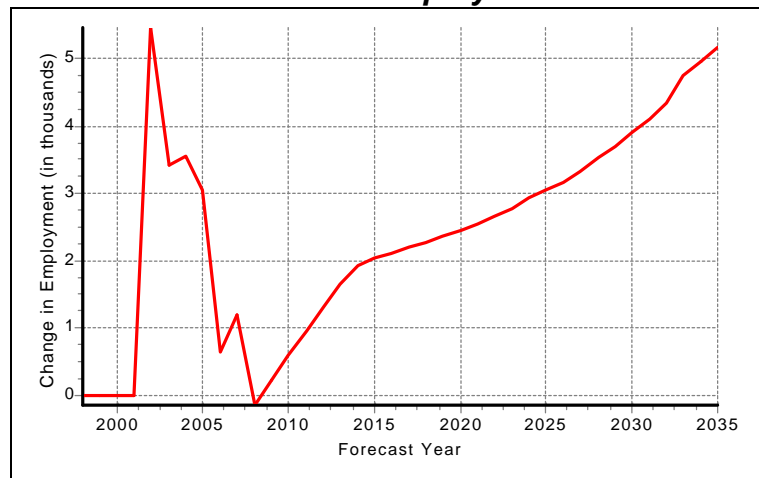
CHANGE IN ECONOMIC INDICATORS DUE TO INVESTMENT IN MULTIPLE PROJECTS

Statewide Gross Regional Product (GRP)



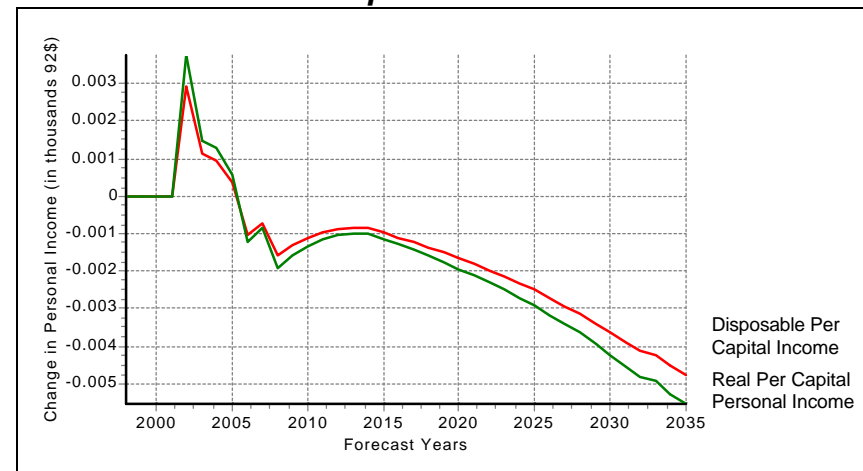
Source: REMI Policy Insight Model

Statewide Employment



Source: REMI Policy Insight Model

Real Per Capita Personal Income



Source: REMI Policy Insight Model

POTENTIAL INDICATORS AND MODELING METHODOLOGIES EXIST FOR MEASURING ECONOMIC WELL-BEING AS CURRENTLY DEFINED

- Economic well-being is more suited for forecasting than monitoring. Specific causes for changes in the economy cannot be isolated, because many socio-economic factors influence the economy. Including an economic well-being component in reports that monitor the transportation system would be difficult
- The Working Group recommends three potential indicators that forecast the impact of transportation projects relative to economic growth, job creation, and individuals' incomes:
 - Gross regional product
 - Employment
 - Personal income
- These indicators can be supplemented by two other indicators: demand and output
- The adoption of employment and personal income indicators requires the definition of economic well-being to be expanded. The Working Group suggests the following:

"Contributing to California's economic growth and standard of living"

- Regardless of the indicators chosen, REMI can forecast the impacts of transportation investments on economic well-being
- Both individual investments and groups of investments can be analyzed

THE POLICY COMMITTEE SHOULD CONSIDER EXPANDING THE DEFINITION OF ECONOMIC WELL-BEING TO INCLUDE IMPROVEMENTS IN THE STANDARD OF LIVING